

about 0.86 to about 0.94 grams/cubic centimeter and a melt flow index of greater than 10 g/10 minutes.

In the Office Action, the Examiner takes the position that “about 0.94 grams/cubic centimeter,” as disclosed in Lee, encompasses not only values of “greater than 0.94” as originally claimed, but also the more specific range of “0.941 to 0.952” as previously amended. Lee is thus said to anticipate the claimed density range.

While Applicants disagree with both positions for the reasons expressed in their previous Amendment, in order to advance prosecution towards allowance, independent claims 1, 8, and 16 have now been amended to recite a higher density range of “0.95 to 0.97 grams/cubic centimeter” as previously recited in claim 18. Such density range is clearly outside of, and therefore not anticipated by, the density range disclosed in Lee. This was acknowledged in the previous Office Action of September 13, 2002, which did not apply Lee against claim 18.

Claim 16 has been further amended to recite a melt flow index of “greater than 15 g/10 min.” instead of the previously recited range of 23 to 69 g/10 min. The latter range is now recited in new claim 19.

Accordingly, withdrawal of the rejection under §102(e) is respectfully requested for claims 1-6, 8-14, and 16-17.

Claim 18 stands rejected under 35 USC §102(b) as being anticipated by Hurley et al. (US 5,844,009). Claim 18 has now been canceled, but the 0.95-0.97 density range of claim 18 has been incorporated into independent claims 1, 8, and 16.

Hurley discloses foams that are blends of LDPE and a silane-grafted copolymer of ethylene and an alpha-olefin having a density between 0.86 and 0.96 g/cc (abstract). At col. 3, lines 58-65, Hurley discloses that the “MI of the polyolefins is generally between about 0.2 dg/min and about

100 dg/min, preferably, between about 1 dg/min and about 10 dg/min, and most preferably between about 2 dg/min and about 8 dg/min.” It is believed that 1 dg/min is equal to 1 g/ 10 min. Thus, the broadest MI range disclosed is from 0.2 g/10 min to 100 g/10 min, with more preferred ranges being below 10 g/10 min. However, such ranges are only stated with respect to “the polyolefins,” and not with respect to either the LDPE or the silane-grafted ethylene/alpha-olefin copolymer in particular. Thus, Hurley’s disclosed MI range refers to both components of the blend and does not refer to either component individually.

In contrast, the presently-claimed invention specifies that it is the ethylene/alpha-olefin (or other higher density ethylene polymer) component of the blend that has a MI of greater than 10 g/10 minutes. As noted in the Application and in previous correspondence with the Office, by employing an ethylene/alpha-olefin copolymer with a MI greater than 10 g/10 min in a blend with LDPE, the resultant foams exhibit unexpected advantages over foams in which the ethylene/alpha-olefin copolymer has a lower MI, including better cell formation and appearance, and also excellent mechanical properties and foaming efficiency. Hurley does not teach that the silane-grafted ethylene/alpha-olefin copolymer component of the blend should have a MI greater than 10 g/10 min., and similarly provides no suggestion that ethylene/alpha-olefin copolymers having a MI greater than 10 g/10 min would lead to the unexpected benefits obtained when such ethylene polymers are blended with LDPE to make foam as discovered by the Applicants.

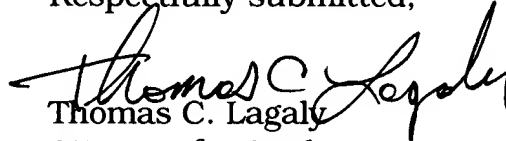
Moreover, as established in the attached Declaration under 37 CFR §1.132, silane-grafting of ethylene polymers, as taught by Hurley, results in a substantial decrease in the melt flow index of such polymers. In order to ascertain the extent of such decrease, Example 1 of Hurley was reproduced to compare the MI of an ethylene/alpha-olefin copolymer with

a silane-grafted version of the same ethylene/alpha-olefin copolymer. As summarized in the table in paragraph 7 of the Declaration, while the non-grafted ethylene/alpha-olefin copolymer had a MI of 21.2, which is greater than 10 g/10 min in accordance with the present invention, silane-grafting thereof per Hurley resulted in a 79% reduction in MI such that the grafted ethylene/alpha-olefin copolymer had a MI of only 4.55. The silane-grafted ethylene/alpha-olefin copolymer according to Hurley, therefore, does not satisfy the claim limitation that the ethylene/alpha-olefin copolymer have a MI of greater than 10 g/10 min. Thus, with respect to Hurley's teaching that the "polyolefins" have a MI between 0.2 and 100 g/10 min, it is apparent that the upper end of this range must pertain to non-grafted polyolefins, while the lower, more preferred ranges, i.e., less than 10 g/10 min, pertain to silane-grafted polyolefins.

Accordingly, Hurley does not anticipate the claimed invention, inasmuch as there is no teaching that the ethylene/alpha-olefin copolymer component of the blend should have a MI of greater than 10 g/10 min as specified in Applicant's claims. Furthermore, since Hurley teaches silane-grafting of the ethylene/alpha-olefin copolymer, which significantly decreases the MI thereof, Hurley does not suggest the claimed MI range of greater than 10 g/10 min. Instead, Hurley teaches away from such range by requiring silane-grafting and, therefore, lower MI. Thus, while Hurley relies on silane-grafting to achieve the results and objectives as stated in the '009 patent, the present invention relies instead on higher MI ethylene/alpha-olefin copolymers that do not have to be silane-grafted. As demonstrated in the Declaration, silane-grafting is a complex and cumbersome process. By avoiding the need for such a process while, at the same time, providing foams of excellent quality, the presently claimed invention provides a distinct advantage over Hurley.

For all of the foregoing reasons, Applicants submit that the claims as now presented are patentably distinct from the references of record and are, therefore, in condition for allowance. A Notice of Allowance is earnestly solicited.

Respectfully submitted,



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May 16, 2003
Date

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Claims 1, 8, and 16 have been amended to read as follows:

1. (Amended Four Times) A foam having a density ranging from about 10 to about 160 kg/m³ and produced from a physical blowing agent, comprising a blend of an aging modifier selected from at least one fatty acid ester, fatty acid amide, or hydroxyl amide, a low density polyethylene, and an ethylene polymer having a density ranging from ~~0.941 to 0.952~~ 0.95 to 0.97 grams/cubic centimeter and a melt flow index of greater than 10 g/10 minutes, said ethylene polymer comprising at least one member selected from ethylene/alpha-olefin copolymer, ethylene homopolymer, and blends thereof.

8. (Amended Four Times) A method of making a foam, comprising:

- a. blending an aging modifier selected from at least one fatty acid ester, fatty acid amide, or hydroxyl amide, a low density polyethylene, and an ethylene polymer having a density ranging from ~~0.941 to 0.952~~ 0.95 to 0.97 grams/cubic centimeter and a melt flow index of greater than 10 g/10 minutes, said ethylene polymer comprising at least one member selected from ethylene/alpha-olefin copolymer, ethylene homopolymer, and blends thereof;
- b. adding a physical blowing agent to said blend; and
- c. causing said blowing agent to expand within said blend,

thereby forming a foam, whereby, said foam has a density ranging from about 10 to about 160 kg/m³.

16. (Twice Amended) A foam, comprising a blend of a low density polyethylene and an ethylene polymer having a density ranging from greater than ~~0.94~~ 0.95 to about 0.97 grams/cubic centimeter and a melt flow index ~~ranging from 23 to 69~~ of greater than 15 g/10 minutes, said ethylene polymer comprising at least one member selected from ethylene/alpha-olefin copolymer, ethylene homopolymer, and blends thereof.

In addition, claim 18 has been canceled.

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Vivian West

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Lee et al.

Group Art Unit: 1711

Serial No.: 09/586,493

Examiner: M. Bissett

Filing Date: June 2, 2000

Docket No.: D-30207-01

Title: FOAM COMPRISING POLYOLEFIN BLEND AND METHOD FOR
PRODUCING SAME

DECLARATION UNDER 37 CFR §1.132

We, Shau-Tarnng Lee ("S. T. Lee") and Natarajan S. Ramesh ("N. S. Ramesh"), declare the following:

1. We are the named inventors in the above-identified patent application.
2. I, S. T. Lee, received a Ph.D. Degree in Chemical Engineering from Stevens Institute of Technology, Hoboken, New Jersey in 1986; a Master of Engineering Degree from the same Department and Institute in 1982, and a Bachelor of Engineering Degree in Industrial Chemistry from National Tsing Hua University, Hsin-Chu, Taiwan, ROC, in 1978. I have been employed by Sealed Air Corporation since 1986 as a researcher in the field of polyolefin foam extrusion.

3. I, N. S. Ramesh, received a PhD in Chemical Engineering from Clarkson University, Potsdam, NY, in 1992; a M.S. Degree in Chemical Engineering from Clarkson University, Potsdam, NY, in 1985; and a B.Tech degree in Chemical Engineering from the Coimbatore Institute of Technology, which is affiliated with the University of Madras, Madras, India, in 1982. I have been employed by Sealed Air Corporation since 1992 as a researcher in the field of polyolefin-based foams.

4. We have read and understand the disclosure set forth in U.S. Pat. No. 5,844,009 ("Hurley"). Hurley discloses foams that are blends of LDPE and a silane-grafted copolymer of ethylene and an alpha-olefin having a density between 0.86 and 0.96 g/cc. In Example 1, Hurley sets forth a method for preparing such silane-grafted copolymers, by reacting 100 parts of an ethylene/alpha-olefin copolymer (ENGAGE 8445) with 0.4 parts vinyl trimethoxy silane, 0.02 parts peroxide as the graft initiator, and 0.01 parts (1 percent by weight) dibutyl tin dilaurate catalyst.

5. In accordance with our invention, low density polyethylene (LDPE) is blended with a higher density ethylene/alpha-olefin copolymer or other higher density ethylene polymer in order to provide a foam with improved mechanical properties. During experimentation, however, we found that when the melt flow index (MI) of such higher density ethylene polymers is less than 10 g/10 min. (ASTM D-1238), the shear forces exhibited by the blend increase sharply during extrusion, relative to extruding LDPE alone, resulting in the generation of excess heat. This heat generation was found to degrade the appearance of the resultant foam and lead to inferior mechanical properties due to a high percentage of open cells and non-uniform cell-size and cell-wall thickness. Also, the excess heat

reduced the foaming efficiency, such that the foam had less void volume and therefore higher density for a given amount of blowing agent. These findings are discussed in further detail in the Background of our patent application.

6. Through further experimentation, we surprisingly discovered that, not only could the above-described problems be avoided, but superior quality foams could be produced by blending LDPE with higher density ethylene/alpha-olefin copolymers, or other higher density ethylene polymers, when the melt flow index (MI) of such higher density polymers is greater than 10 g/10 min. Such foams have much better appearance and cell formation than foams made with a low MI (less than 10 g/10 min.) ethylene/alpha-olefin copolymer (see previous Declaration dated December 17, 2001). In addition, the resultant foams also have excellent mechanical properties and foaming efficiency (see the Examples in our patent application).

7. It is known that silane-grafting of ethylene polymers, as taught by Hurley, results in a substantial decrease in the melt flow index of such polymers. In order to determine the extent to which such decrease occurs, we devised and directed the following experiment. First, the MI of an ethylene/alpha-olefin copolymer in accordance with ASTM D-1238 was measured. Next, the teaching of Hurley's Example 1 was followed in order to produce a silane-grafted version of the same ethylene/alpha-olefin copolymer. The MI of the grafted copolymer was then measured in accordance with ASTM D-1238 and compared to the MI of the non-grafted copolymer. As discussed in further detail below, the decrease in MI was found to be significant.

8. Accordingly, as in Example 1 of Hurley, we reacted 100 parts of an ethylene/alpha-olefin copolymer (NOVA 2024A, an ethylene/butene copolymer) with 0.4 parts vinyl trimethoxy silane, 0.02 parts dicumyl peroxide as the graft initiator, and 0.01 parts dibutyl tin dilaurate catalyst. The silane, peroxide, and catalyst were obtained from the Aldrich Company.

9. Procedurally, peroxide crystals were first dissolved in methyl ethyl ketone (MEK), and then tumble-blended with the ethylene/alpha-olefin copolymer in such a manner that the designated ratio of 0.02 parts of peroxide per 100 parts ethylene/alpha-olefin copolymer was obtained. After thorough blending, MEK was allowed to evaporate for 24 hrs before 0.4 parts of the silane was added to the mixture and tumble-blended. The premix of ethylene/alpha-olefin copolymer, silane and peroxide were fed to a twin-screw extruder for grafting, in which a final barrel zone temperature of approximately 179 to 180 °C was maintained. The extrudates were cooled through a water trough and chopped off via a pelletizer. The resultant silane-grafted ethylene/alpha-olefin copolymer pellets were allowed to dry over night before 0.01 parts dibutyl tin dilaurate were mixed with the pellets, re-compounded in the twin-screw extruder, then re-pelletized. The resultant pellets were soaked in water for 66 hours and dried under air for one hour prior to being vacuum dried at 60 °C for 2.5 hours. Finally, the pellets were mixed with 2% Irganox 1010 anti-oxidant and the melt index was measured using a Tinius Olsen Extrusion Plastometer in accordance with ASTM D-1238. The data are shown in the following table.

Resin	Melt Flow Ind x* (grams/10 minutes)
NOVA 2024A	21.2
Silane-Grafted NOVA 2024A	4.55


*MI determined in accordance with ASTM D-1238 at 190 °C using 2.16 Kg.

10. As indicated by the data set forth above, silane-grafting of ethylene/alpha-olefin copolymers results in a substantial decrease in melt flow index, i.e., in comparison to the same non-grafted ethylene/alpha-olefin copolymer. In the data above, the MI of the ethylene/alpha-olefin copolymer decreased from 21.2 to 4.55, which is a decrease of 79%, as a result of silane-grafting as taught by Hurley.

11. Accordingly, it is apparent that foams produced from the blend of LDPE and silane-grafted ethylene/alpha-olefin copolymer as disclosed in Hurley are quite different from foams in accordance with our invention because our foams require that ethylene/alpha-olefin copolymer blended with LDPE have a MI that is greater than 10g/10 min. In contrast, silane-grafting as taught by Hurley resulted in a significant decrease in the MI of an ethylene/alpha-olefin copolymer such that it did not meet our claim requirement of at least 10 g/10 min.

12. We further declare that all statements made herein of our own knowledge are true, and that all statements made herein on information and belief are believed to be true. Such statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the present application or any patent issuing therefrom.

Declared this 15th day of May, 2003


Shau-Tung Lee

Natarajan S. Ramesh



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Vivian West

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Declared this 15 th day of May, 2003

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